

ASSP

IF Band PLL Frequency Synthesizer

MB15C101

■ DESCRIPTION

The Fujitsu Microelectronics MB15C101 is an exclusive Intermediate Frequency (IF) band Phase Locked Loop (PLL) frequency synthesizer with pulse swallow operation. The reference divider and comparison divider have fixed divide ratios, so that it is not required to set the divide ratios by a microcontroller externally.

It operates with a supply voltage of 3.0 V typ. and dissipates 1.0 mA typ.(270MHz) of current realized through the use of Fujitsu Microelectronics's CMOS technology.

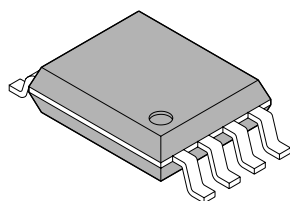
The MB15C101 is ideally suitable for PHS systems.

■ FEATURES

- Low power supply current: $I_{CC} = 1.0 \text{ mA}$ typ. ($V_{CC} = 3 \text{ V}$, 270MHz)
- Pulse swallow function; Prescaler: 16/17
- Setting frequency (Selectable by Div input.)
 - $f_{osc} = 19.2 \text{ MHz}$, $f_{IF} = 233.15 \text{ MHz}$ (Div = "H")
 - $f_{osc} = 19.2 \text{ MHz}$, $f_{IF} = 259.20 \text{ MHz}$ (Div = "L")
- Lock detector
- Low power supply voltage: $V_{CC} = 2.4 \text{ V}$ min.
- Wide operating temperature: $T_a = -40$ to $+85^\circ\text{C}$

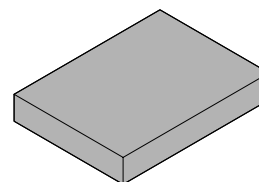
■ PACKAGE

8-pin plastic SSOP



(FPT-8P-M03)

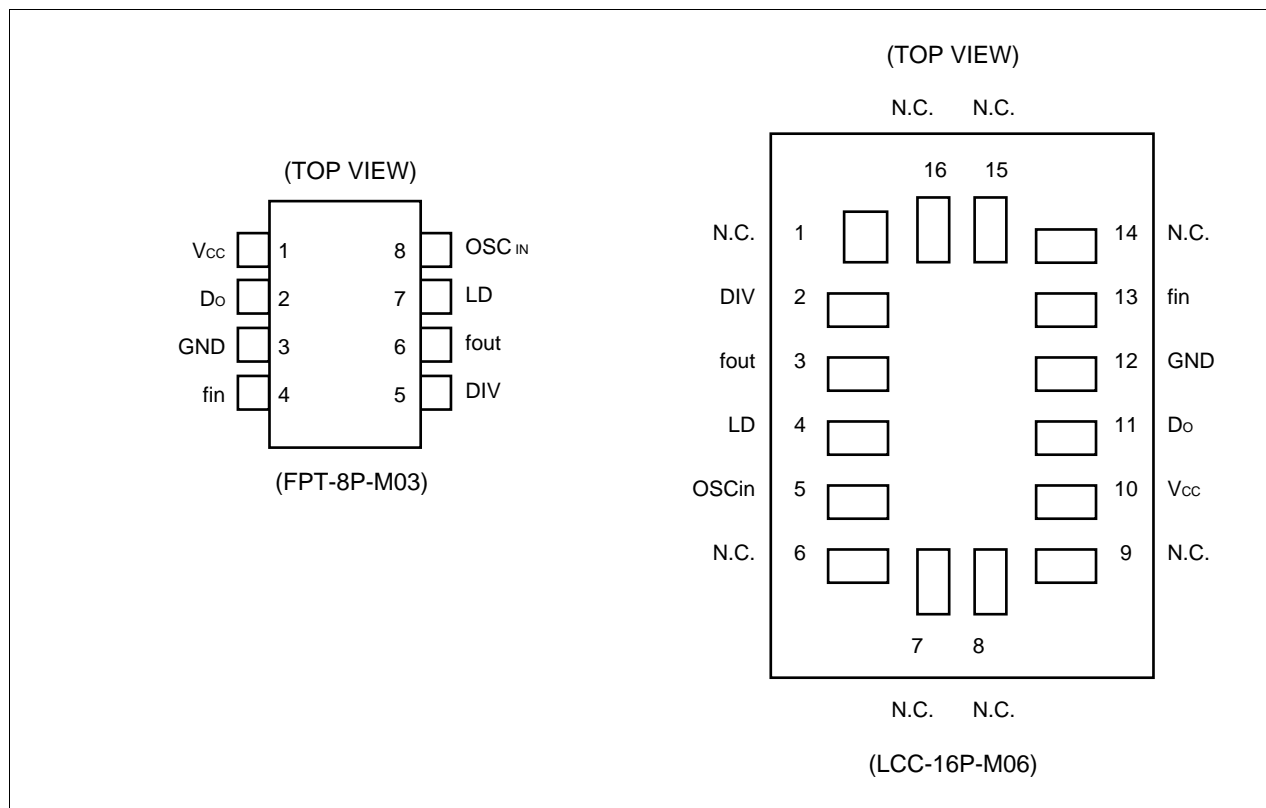
16-pad plastic BCC



(LCC-16P-M06)

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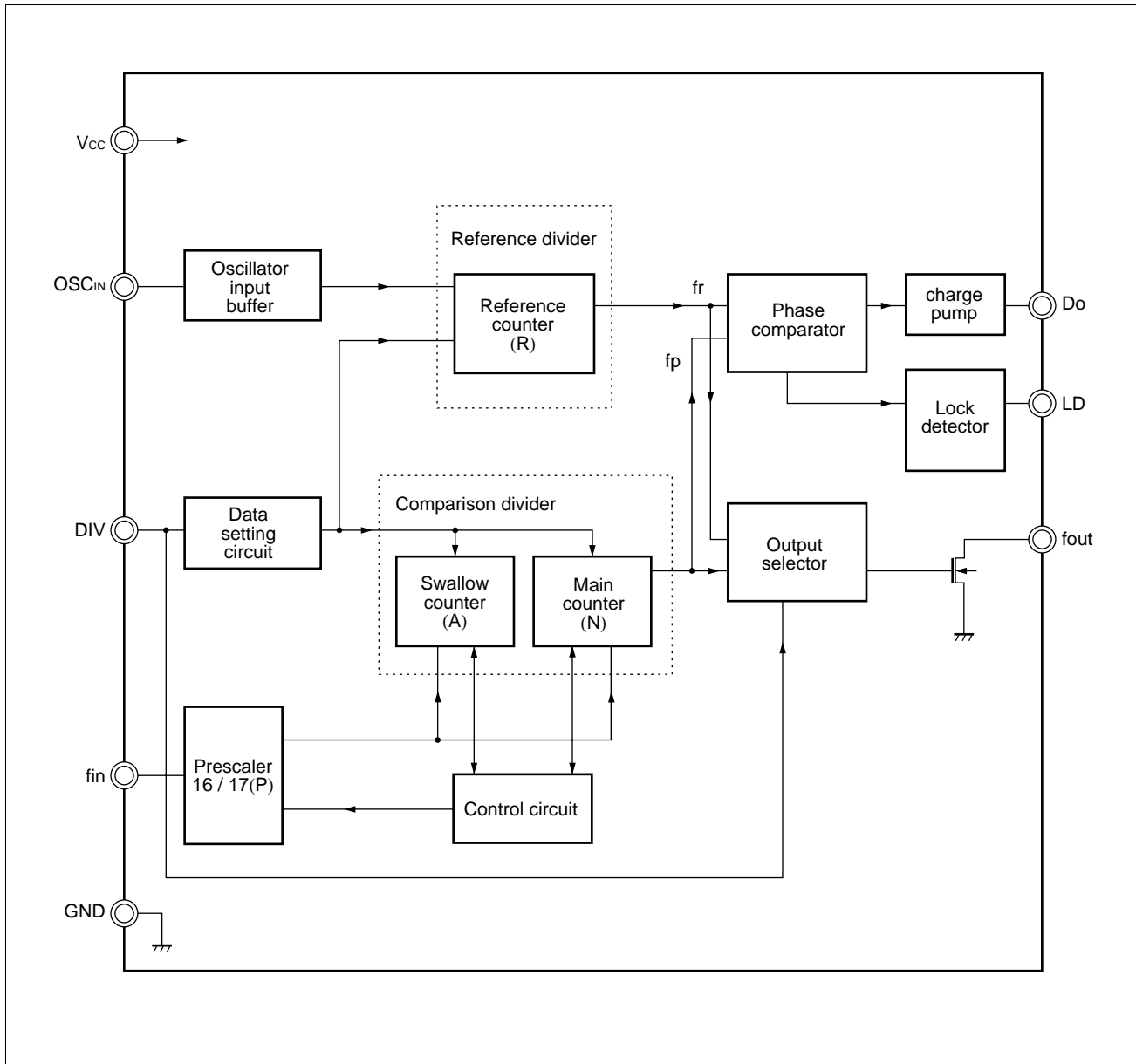
■ PIN ASSIGNMENT



■ PIN DESCRIPTIONS

Pin No.		Pin name	I/O	Descriptions
SSOP-8	BCC-16			
–	1,6,7,8,9,14,15,16	N.C	–	No connection
1	10	V _{CC}	–	Power supply voltage input (2.4 V to 3.6 V).
2	11	D _O	O	Charge pump output
3	12	GND	–	Ground
4	13	fin	I	Prescaler input. Connection should be with AC coupling.
5	2	Div	I	Divide ratio switching input. Two kinds of divide ratios are selectable by Div input “H” or “L”.
6	3	fout	O	Test purpose output. This pin is an open drain output so that should be left open usually.
7	4	LD	O	Lock detector output. LD = H ; Lock LD = L ; Unlock
8	5	OSC _{IN}	I	Reference counter input. Connection should be with AC coupling.

■ BLOCK DIAGRAM



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■ ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Rating		Unit
		Min.	Max.	
Power supply voltage	V_{CC}	-0.5	+4.0	V
Input voltage	V_I	-0.5	$V_{CC} + 0.5$	V
Output voltage	V_{OUT}	-0.5	$V_{CC} + 0.5$	V
Output current	I_{OUT}	0	+5	mA
Storage temperature	T_{STG}	-55	+125	°C

WARNING: Semiconductor devices can be permanently damaged by application of stress (voltage, current, temperature, etc.) in excess of absolute maximum ratings. Do not exceed these ratings.

■ RECOMMENDED OPERATING CONDITIONS

Parameter	Symbol	Value			Unit	Note
		Min.	Typ.	Max.		
Power supply voltage	V_{CC}	2.4	3.0	3.6	V	
Input voltage	V_{IN}	GND	-	V_{CC}	V	
Operating temperature	T_a	-40	-	+85	°C	

Handling Precautions

- This device should be transported and stored in anti-static containers.
- This is a static-sensitive device; take proper anti-ESD precautions. Ensure that personnel and equipment are properly grounded. Cover workbenches with grounded conductive mats.
- Always turn the power supply off before inserting or removing the device from its socket.
- Protect leads with a conductive sheet when handling or transporting PC boards with devices.

■ ELECTRICAL CHARACTERISTICS

Recommended operating conditions unless otherwise noted.

Parameter	Symbol	Condition	Value			Unit	
			Min.	Typ.	Max.		
Power supply current	I _{CC}	PLL is locked.(270MHz) V _{CC} = 3.0 V, Ta = +25°C	0.1	1.0	2.0	mA	
Operating frequency	f _{in}	AC coupling by 1000 pF capacitor	50	–	270	MHz	
	OSC _{IN}	AC coupling by 1000 pF capacitor	3	–	26	MHz	
Input sensitivity	f _{in}	AC coupling by 1000 pF capacitor	–10	–	+2	dBm	
	OSC _{IN}	AC coupling by 1000 pF capacitor	0.5	–	–	V _{pp}	
Input voltage	Div	V _{IH}	–	V _{CC} × 0.7	–	V	
		V _{IL}	–	–	V _{CC} × 0.3	V	
Input current	Div	I _{IH}	–	–	1.0	μA	
		I _{IL}	–	–1.0	–	μA	
Input current	OSC _{IN}	I _{OSC}	–	–100	100	μA	
Output voltage	Do	V _{OH}	V _{CC} = 3.0 V, I _{OH} = –0.3mA	2.6	–	–	V
		V _{OL}	V _{CC} = 3.0 V, I _{OL} = 0.3mA	–	–	0.4	V
Output current	Do	I _{OH}	V _{CC} = 3.0 V, V _{OH} = 2V, Ta = +25°C	–	–6.0	–	mA
		I _{OL}	V _{CC} = 3.0 V, V _{OL} = 1V, Ta = +25°C	–	6.0	–	mA
High impedance cut off current	Do	I _{OFF}	0 ≤ V _{DO} ≤ V _{CC}	–	–	3	nA

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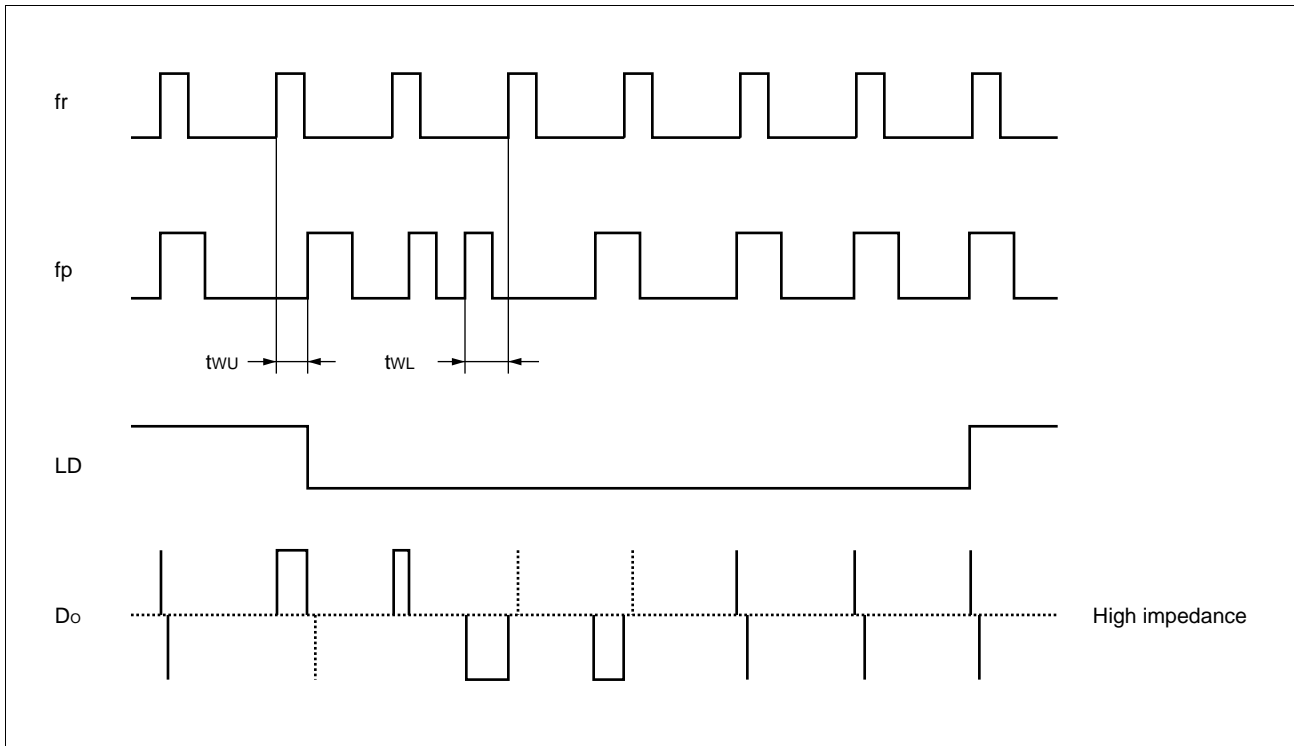
FUNCTIONAL DESCRIPTIONS

Two different frequencies can be selected by Div input “H” or “L”.
The divide ratios are calculated using the following equation:

$$f_{vco} = \{(P \times N) + A\} \times f_{osc} \div R \quad (A < N)$$

Symbol	Description	Div = “H”	Div = “L”
f _{vco}	Output frequency of external VCO	233.15 MHz	259.20 MHz
f _{osc}	Reference oscillation frequency	19.2 MHz	19.2 MHz
N	Divide ratio of the main counter	291	33
A	Divide ratio of the swallow counter	7	12
P	Preset divide ratio of dual modulus prescaler	16/17	16/17
R	Divide ratio of the reference counter	384 (fr = 50 kHz)	40 (fr = 480 kHz)

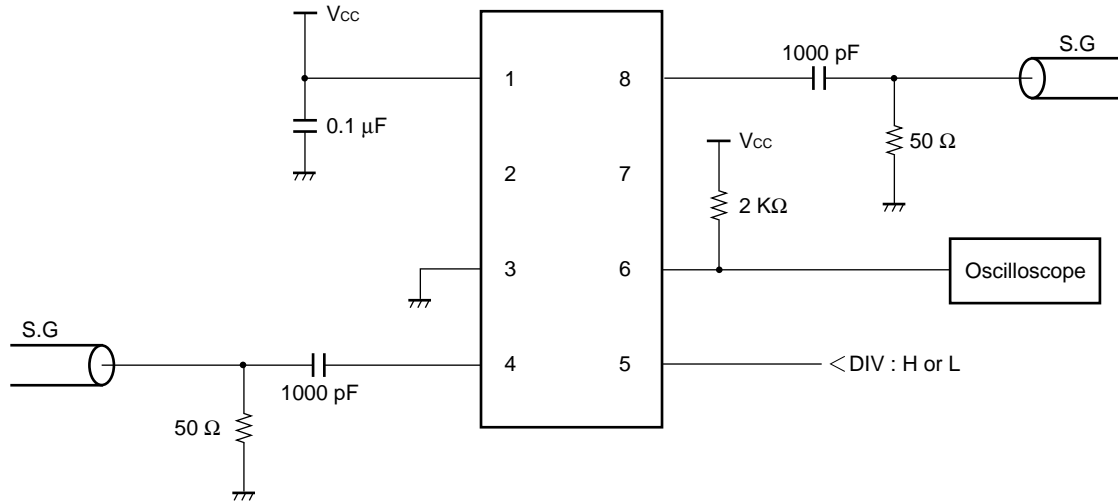
PHASE DETECTOR TIME CHART



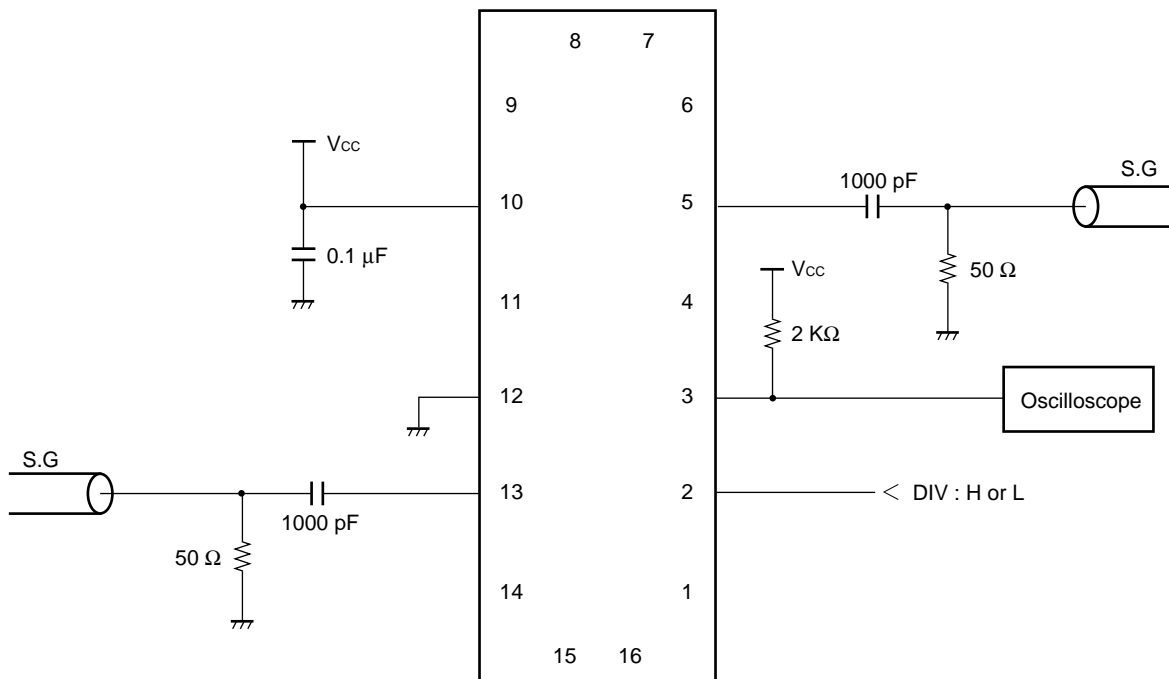
- Note:
- Phase error detection range: -2π to $+2\pi$
 - Pulses on Do output signal during locked state are output to prevent dead zone.
 - LD output becomes low when phase is t_{wU} or more. LD output becomes high when phase error is t_{wL} or less and continues to be so for three cycles or more.
 - t_{wU} and t_{wL} depend on OSCin input frequency.
 - $t_{wU} \geq 8/f_{osc}$ (s) (e. g. $t_{wU} \geq 625.0ns$, $f_{osc} = 12.8$ MHz)
 - $t_{wL} \leq 16/f_{osc}$ (s) (e. g. $t_{wL} \leq 1250.0ns$, $f_{osc} = 12.8$ MHz)

MEASUREMENT CIRCUIT (for measuring input sensitivity fin/OSCin)

SSOP-8



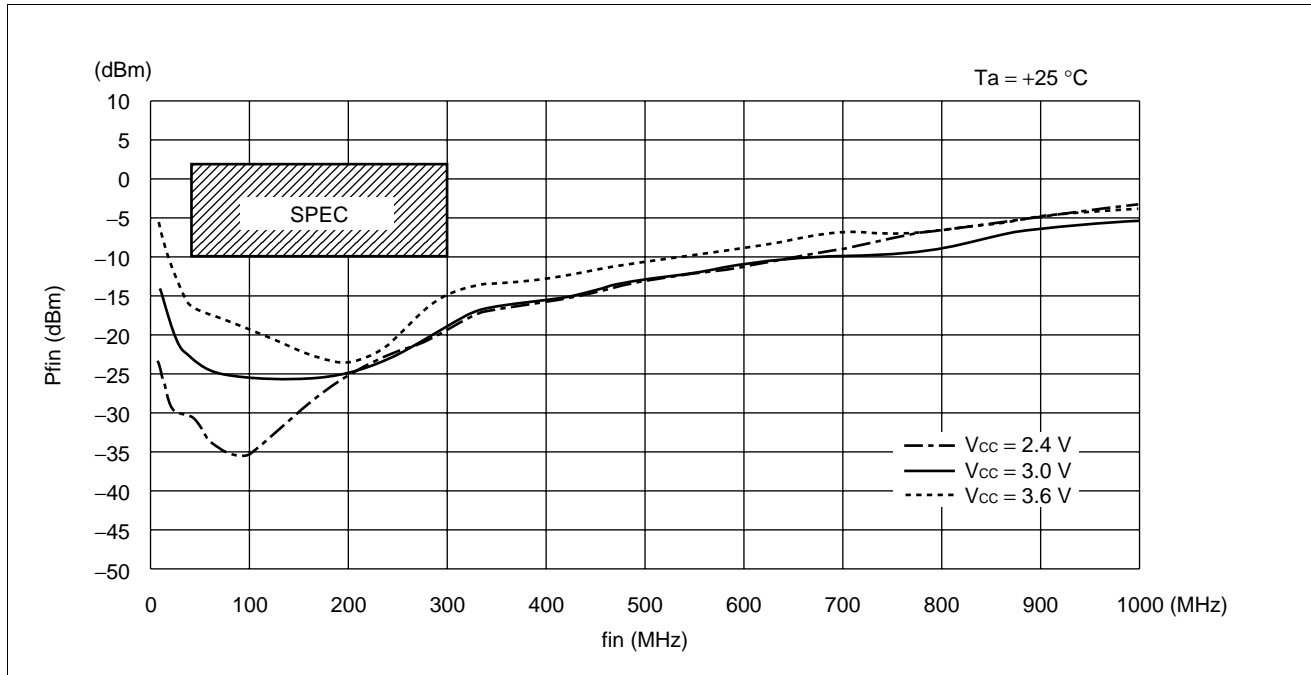
BCC-16



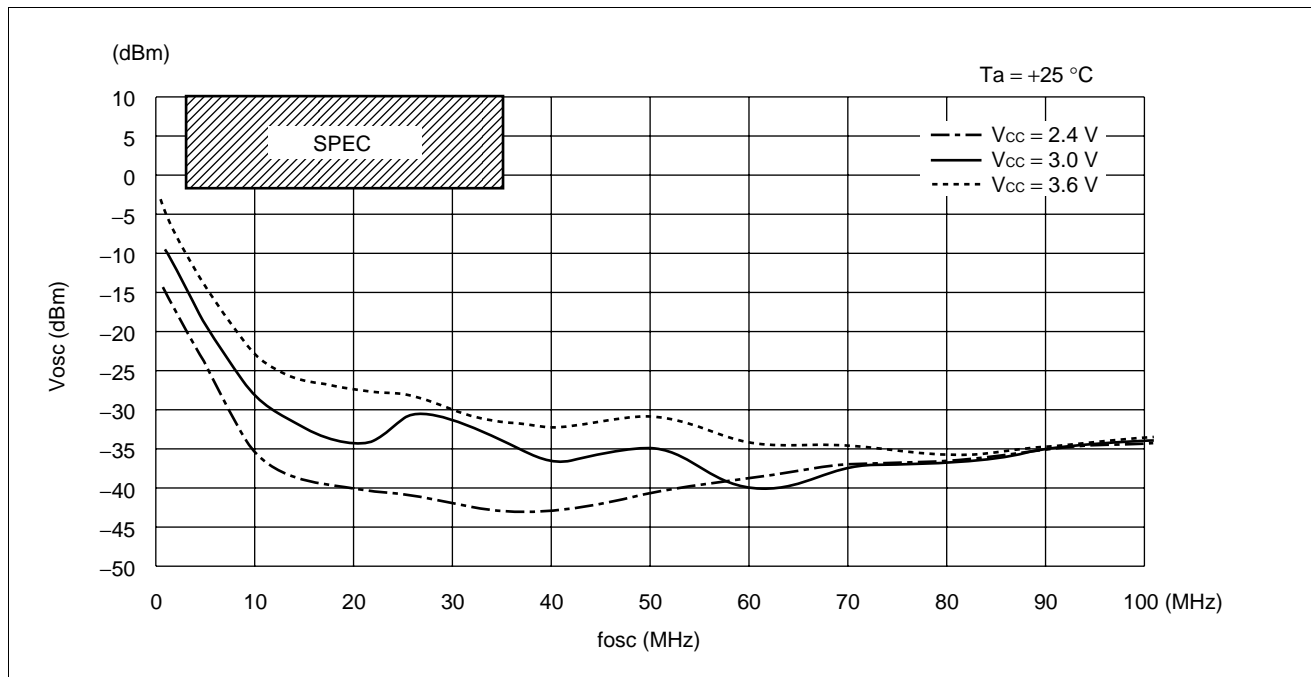
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■ TYPICAL CHARACTERISTICS

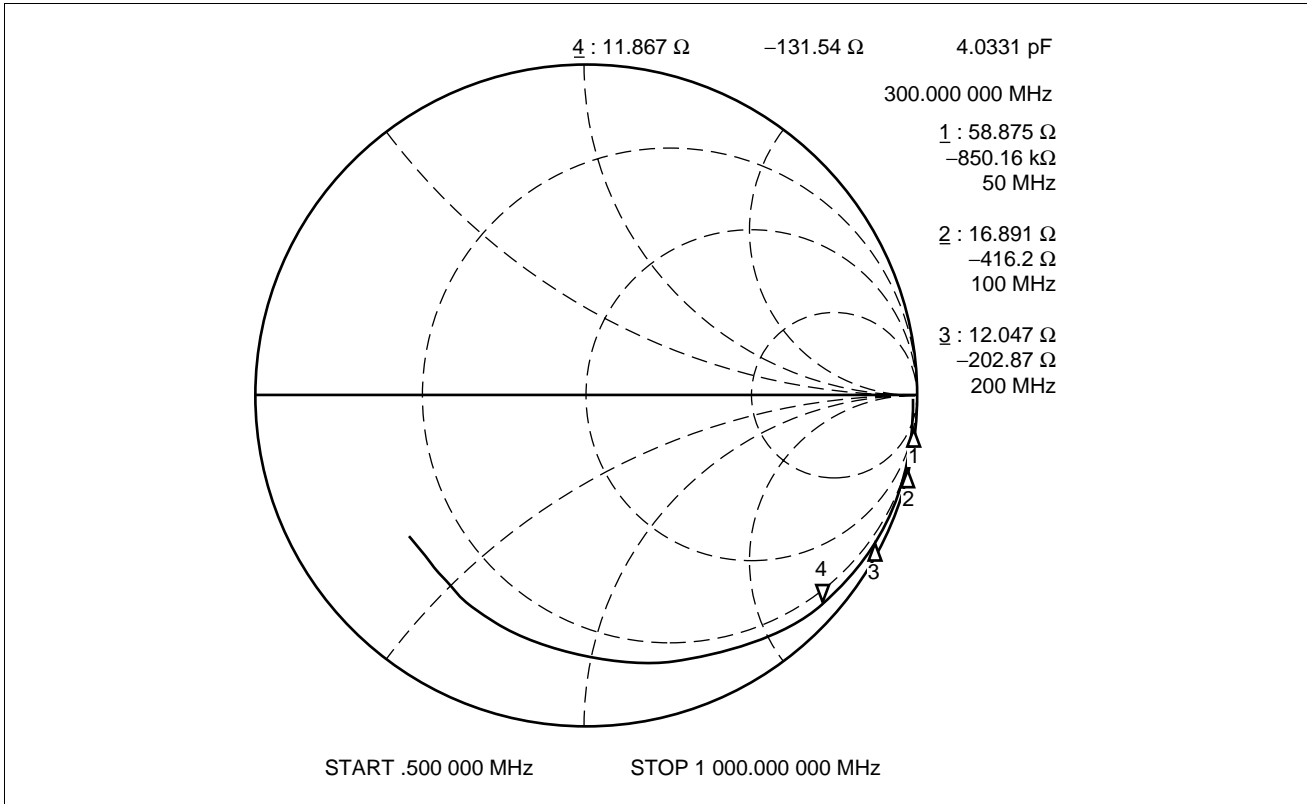
1. f_{in} Input Sensitivity



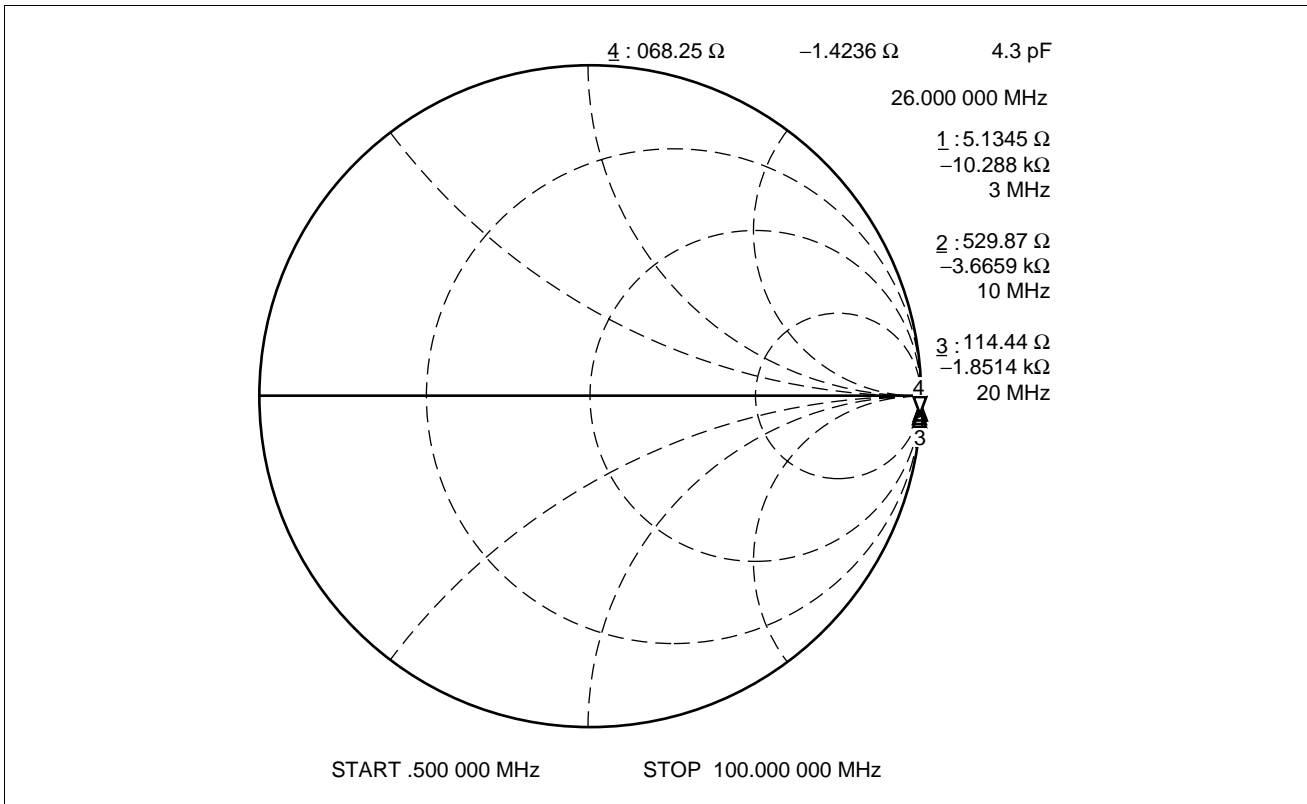
2. OSC_{IN} Input Sensitivity



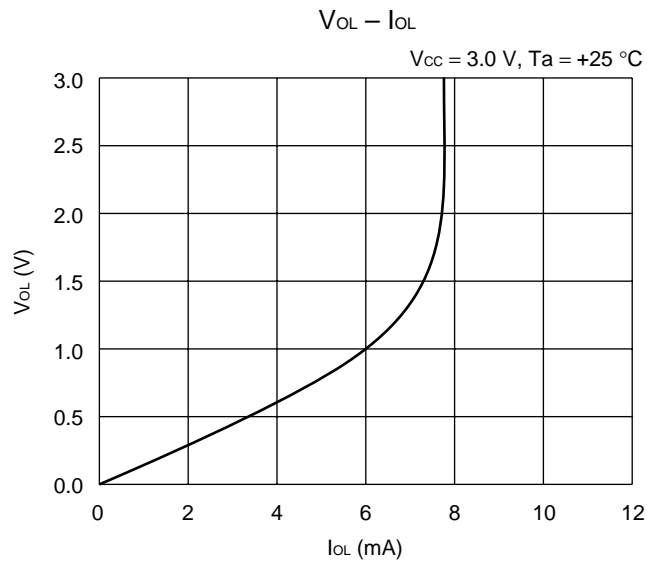
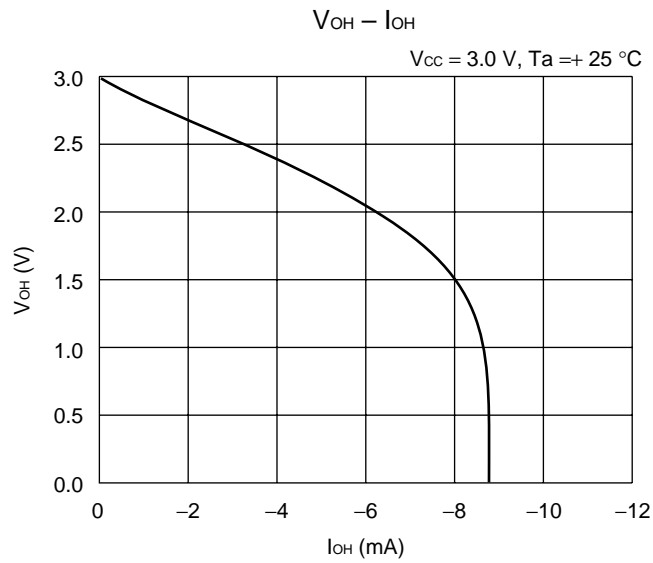
3. fin Input Impedance



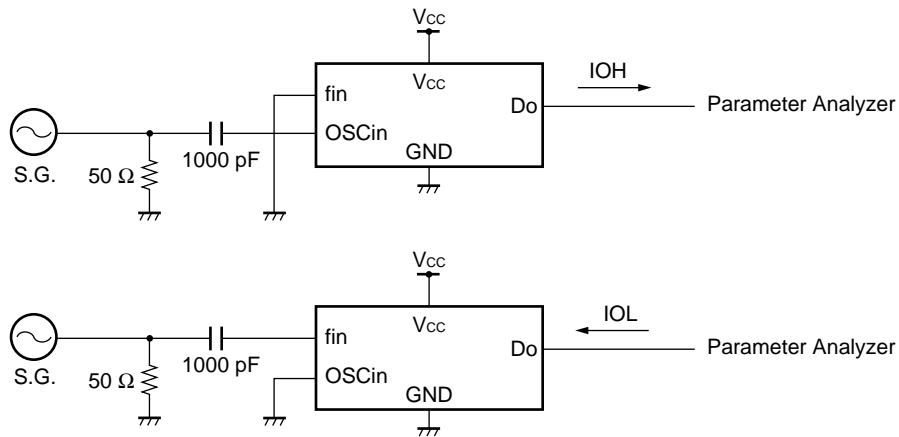
4. OSC_{IN} Input Impedance



5. Do Outut Current



Measurement Circuit



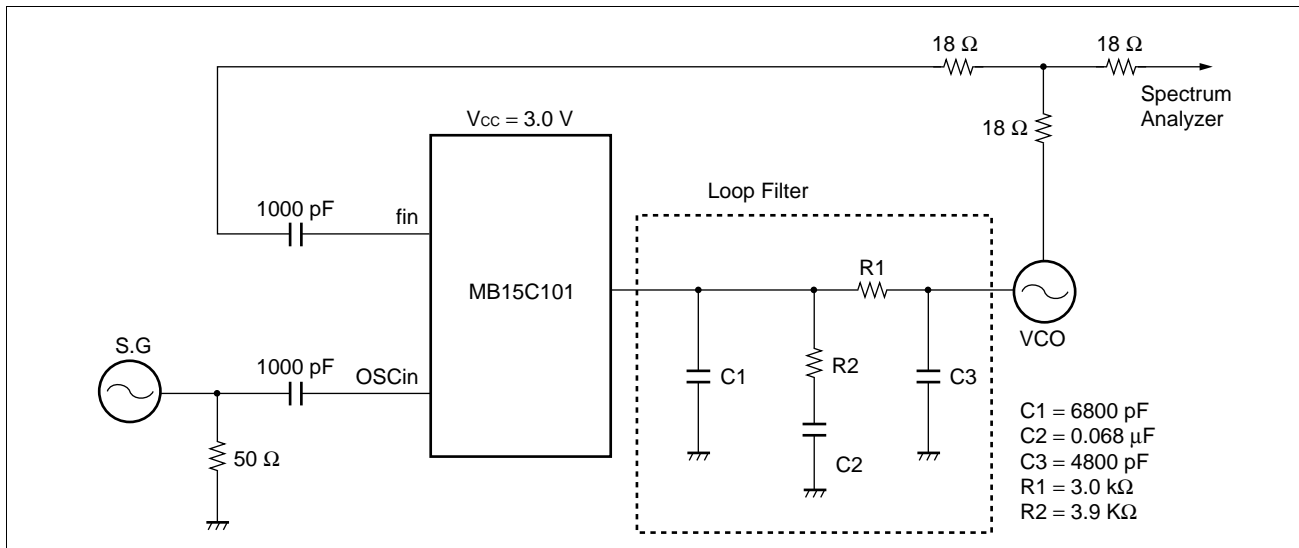
■ REFERENCE INFORMATION

1. Application Measurement

- Test Results

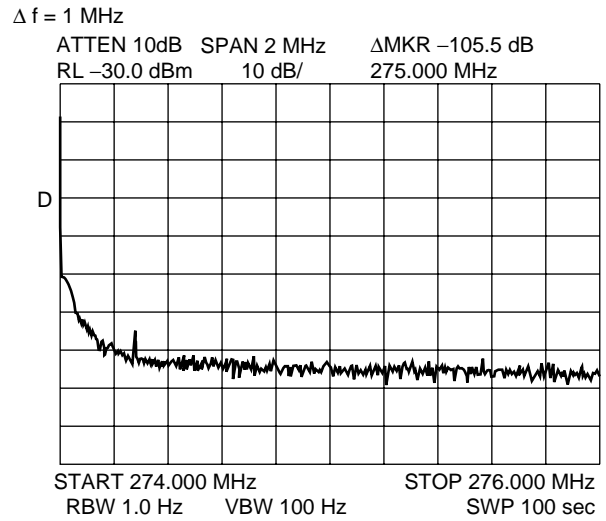
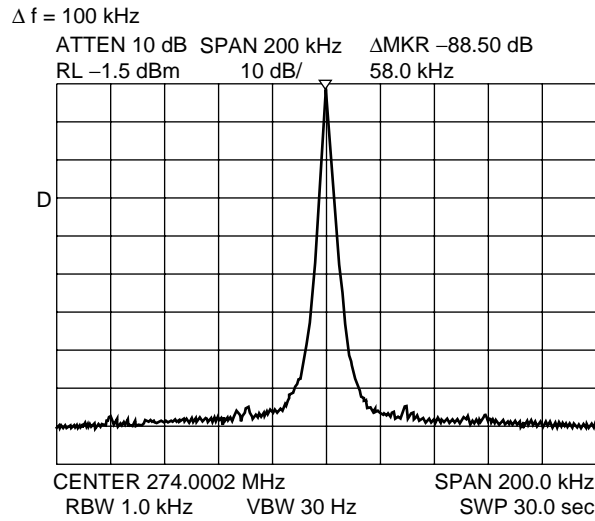
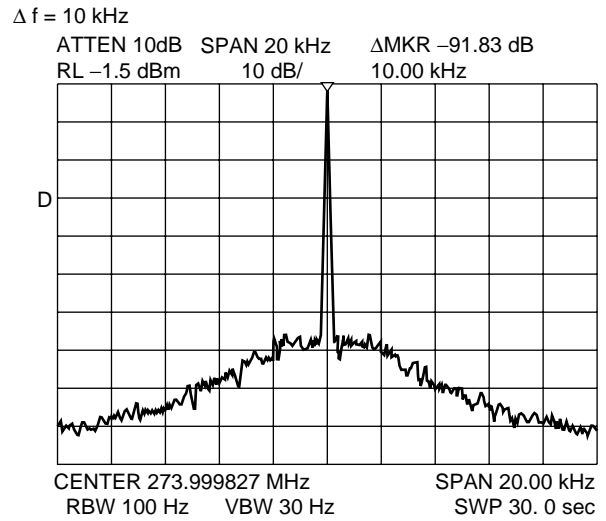
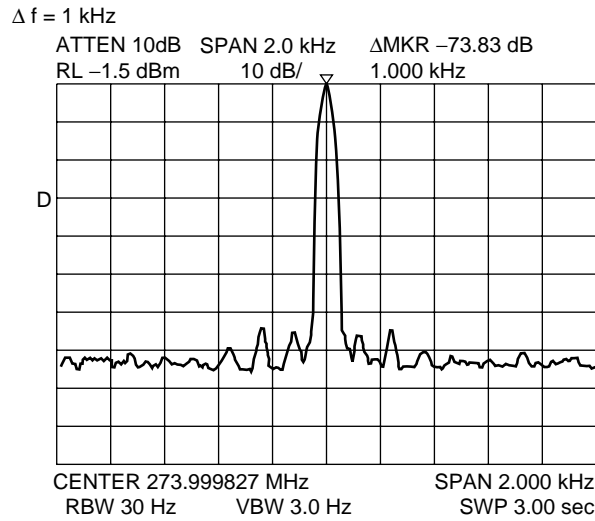
	Results
Lockup time ± 1 kHz Un lock \rightarrow Lock Power on \rightarrow Lock	2.3 ms 3.4 ms
Reference leakage ($\Delta f = 58$ kHz)	-88.5 dBc
Phase noise ($\Delta f = 1$ kHz) ($\Delta f = 10$ kHz) ($\Delta f = 100$ kHz) ($\Delta f = 1$ MHz)	-88.0 dBc/Hz -111.0 dBc/Hz -118.0 dBc/Hz -134.0 dBc/Hz
V _{CC} (V)	3.0 V
VCO	Discrete VCO ($K_v = 3.5$ MHz/V) Lock Frequency = 274.0 MHz ($f_r = 58$ kHz)

- Measurement Circuit

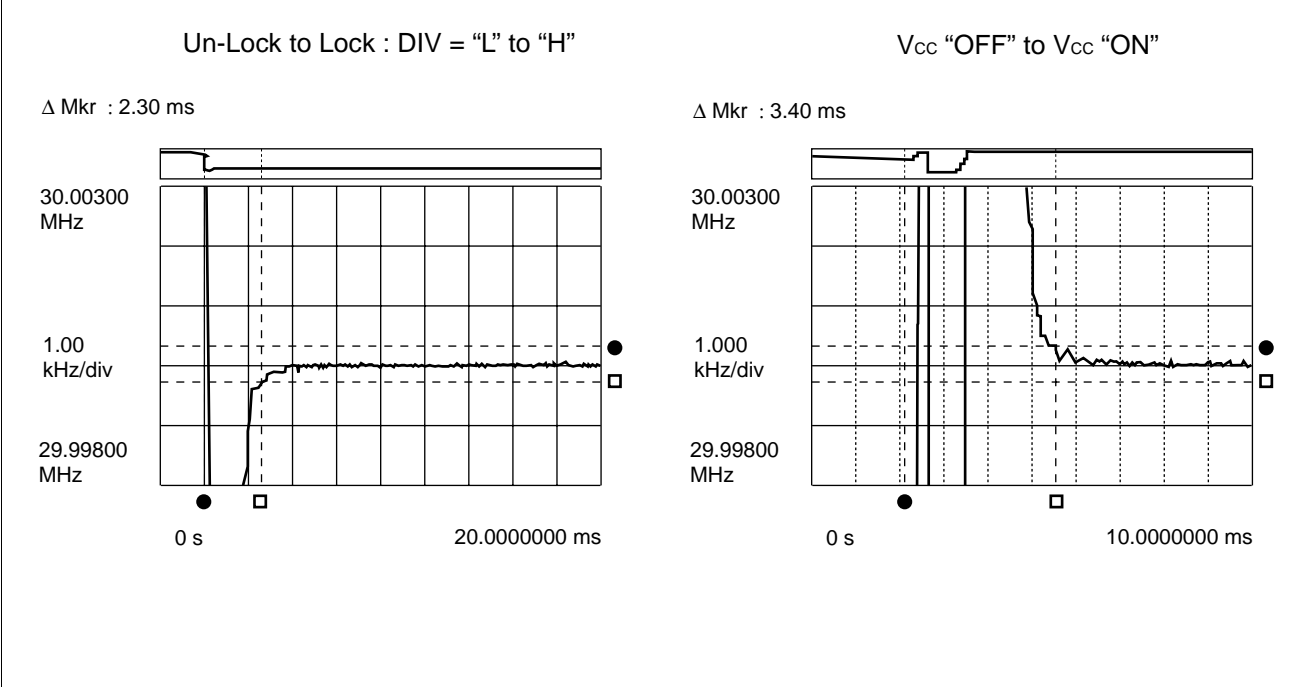


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2. Phase Noise



3. Lockup Time: Un-Lock to Lock

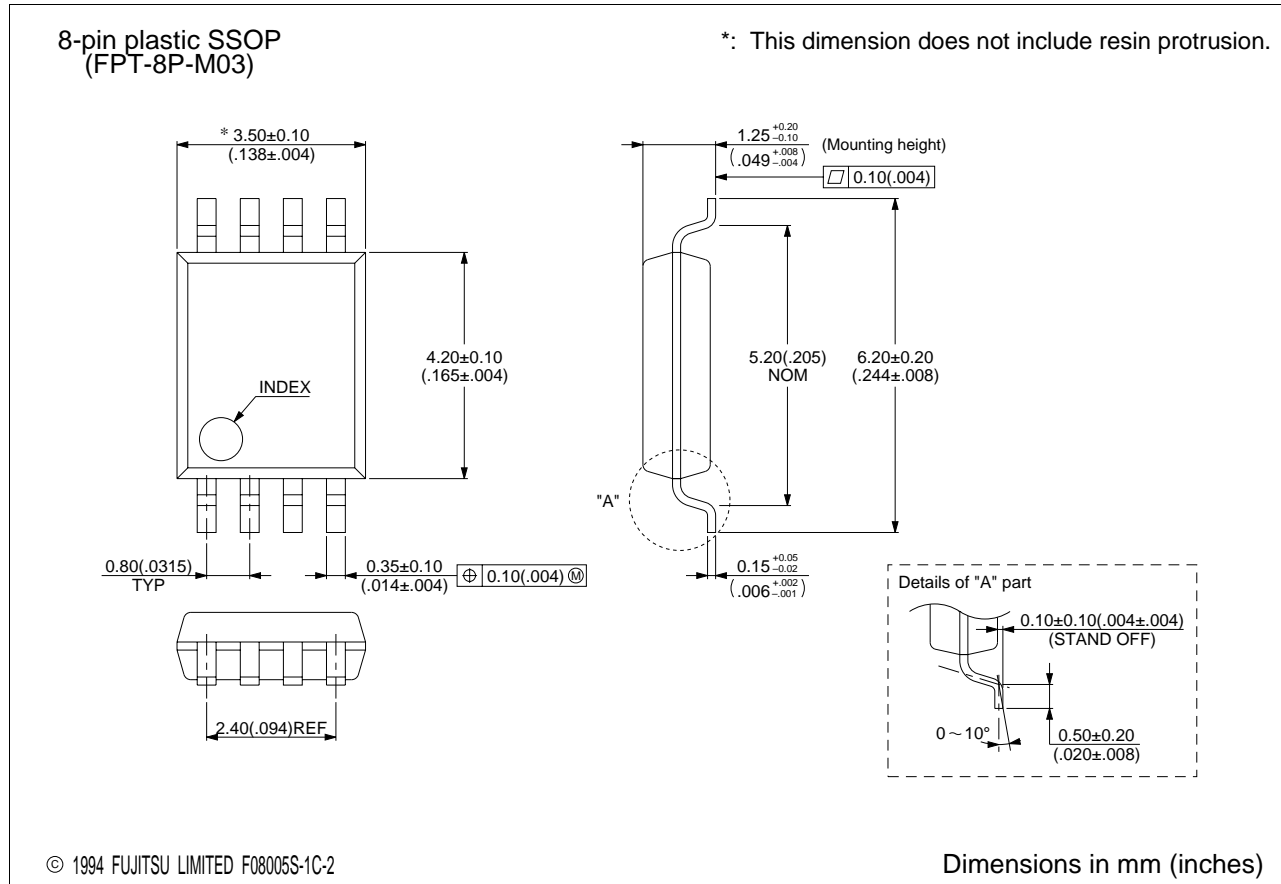


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■ ORDERING INFORMATION

Part number	Package	Remarks
MB15C101PFV	8-pin, Plastic SSOP (FPT-8P-M03)	
MB15C101PV1	16-pad, Plastic BCC (LCC-16P-M06)	

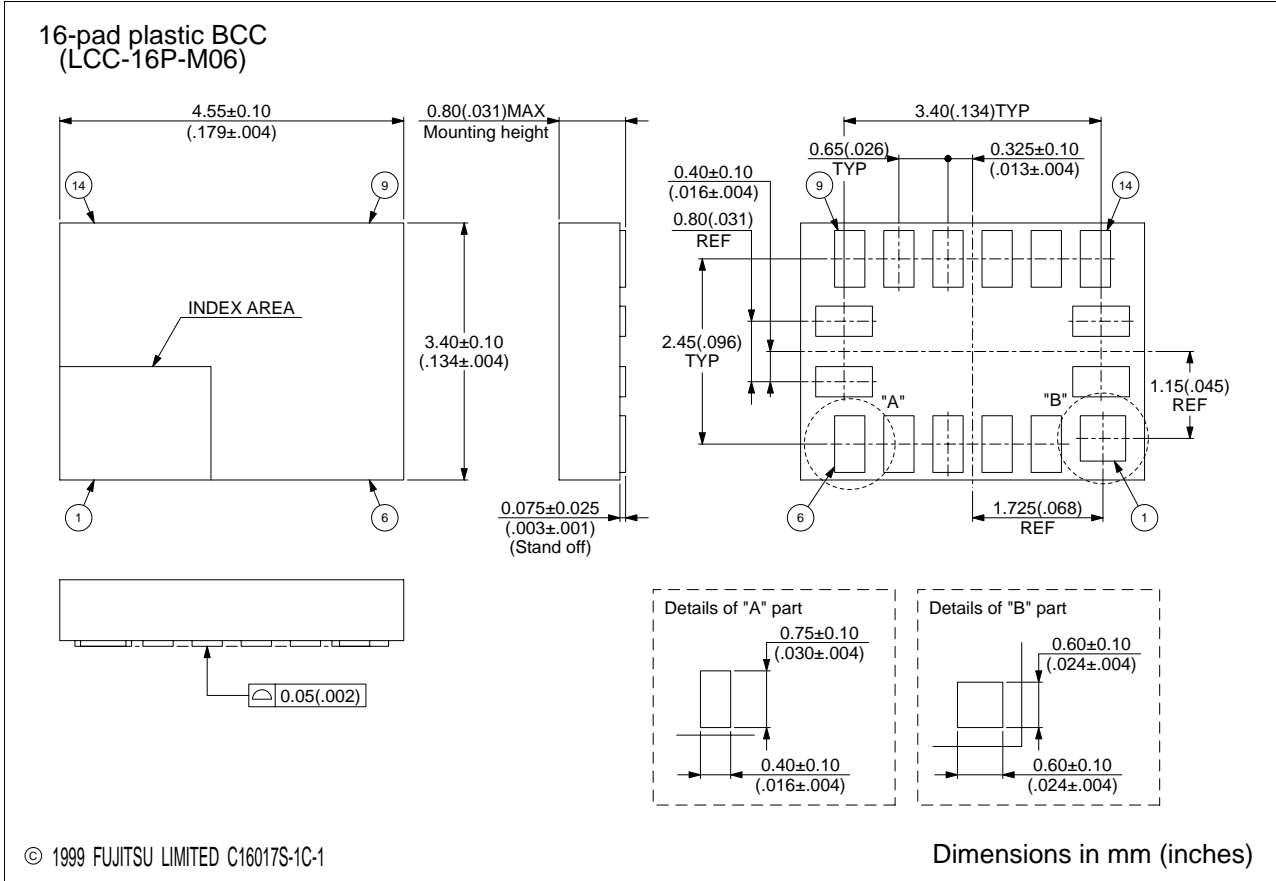
■ PACKAGE DIMENSIONS



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FUJITSU MICROELECTRONICS LIMITED

Shinjuku Dai-Ichi Seimei Bldg. 7-1, Nishishinjuku 2-chome, Shinjuku-ku,
Tokyo 163-0722, Japan Tel: +81-3-5322-3347 Fax: +81-3-5322-3387
<http://jp.fujitsu.com/fml/en/>

For further information please contact:

North and South America

FUJITSU MICROELECTRONICS AMERICA, INC.
1250 E. Arques Avenue, M/S 333
Sunnyvale, CA 94085-5401, U.S.A.
Tel: +1-408-737-5600 Fax: +1-408-737-5999
<http://www.fma.fujitsu.com/>

Europe

FUJITSU MICROELECTRONICS EUROPE GmbH
Pittlerstrasse 47, 63225 Langen,
Germany
Tel: +49-6103-690-0 Fax: +49-6103-690-122
<http://emea.fujitsu.com/microelectronics/>

Korea

FUJITSU MICROELECTRONICS KOREA LTD.
206 KOSMO TOWER, 1002 Daechi-Dong,
Kangnam-Gu, Seoul 135-280
Korea
Tel: +82-2-3484-7100 Fax: +82-2-3484-7111
<http://www.fmk.fujitsu.com/>

Asia Pacific

FUJITSU MICROELECTRONICS ASIA PTE LTD.
151 Lorong Chuan, #05-08 New Tech Park,
Singapore 556741
Tel: +65-6281-0770 Fax: +65-6281-0220
<http://www.fujitsu.com/sg/services/micro/semiconductor/>

FUJITSU MICROELECTRONICS SHANGHAI CO., LTD.
Rm.3102, Bund Center, No.222 Yan An Road(E),
Shanghai 200002, China
Tel: +86-21-6335-1560 Fax: +86-21-6335-1605
<http://cn.fujitsu.com/fmc/>

FUJITSU MICROELECTRONICS PACIFIC ASIA LTD.
10/F., World Commerce Centre, 11 Canton Road
Tsimshatsui, Kowloon
Hong Kong
Tel: +852-2377-0226 Fax: +852-2376-3269
<http://cn.fujitsu.com/fmc/tw>

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